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Ricin: Technical Background and Potential Role in Terrorism

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Summary

On February 2, 2004, the deadly toxin ricin was detected in the Dirksen Senate Office Building. Ricin, derived from castor beans, has been identified as a potential bioweapon. Ricin is extremely toxic by ingestion, inhalation and injection, causing organ damage that can lead to death. While research continues on new therapies and vaccines against ricin exposure, no approved treatments or prophylaxis for human use currently exist. Research to develop sensitive, portable detectors capable of detecting the release of ricin is ongoing. Although ricin was investigated as a potential military weapon, it has predominantly been used in small quantities against specific individuals. Most experts believe that ricin would be difficult to use as a weapon of mass destruction, but do not discount its potential as a weapon of terror. Ricin is on the Centers for Disease Control and Prevention Select Agent list, and its possession, transfer, or use, is regulated under domestic and international law. This report will be updated as events warrant.

Introduction

On February 2, 2004, the deadly toxin ricin was detected in the Dirksen Senate Office Building. As of this writing, early indications suggest that the toxin may have been mailed to Senator Frist's offices. All mail sent to government offices on Capitol Hill is sterilized by irradiation. However, this procedure was designed to kill bacteria, such as anthrax, not to inactivate preformed toxins such as ricin. Ricin is often mentioned as a potential bioterror weapon. This report describes what ricin is, how it is made, its effects, a brief history of its use, its potential for use as a bioterror weapon, and how it is currently regulated.

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What Is Ricin?

Ricin is a potent plant toxin found in the seeds of the castor plant (*Ricinus communis*). It works by blocking cell protein synthesis, which results in cell death. If enough cells die, lesions appear in the exposed tissues which can lead to organ failure and death of the victim.¹

How Is Ricin Obtained?

Ricin can be isolated from castor beans by several well known processes. During the industrial production of castor oil, bean mash with approximately 5 percent ricin content is produced. Recipes for extracting the ricin from this mash are widely available for purchase on the Internet and from commercial bookstores.²

Effects of Ricin

Persons exposed to ricin exhibit different symptoms depending on the route of exposure. Ingestion of ricin causes nausea, vomiting, diarrhea, gastric hemorrhaging and shock. With a sufficient dose, death occurs within 3 to 5 days. Injection of ricin produces severe internal bleeding and tissue death, which can result in the collapse of major organ systems. Death often follows such a collapse. Ricin inhalation irritates the lung linings and airways, leading to weakness and fever. Following this stage, pulmonary lesions may occur causing tissue swelling, and further pulmonary damage.³

The lethal dosage of ricin depends on the mode of exposure. Inhaled or injected doses as low as 3 to 5 micrograms per kilogram body weight may be lethal.⁴ This dose equals 240 to 400 micrograms for a 175 pound individual.⁵ Because ricin is less well absorbed in the gastrointestinal tract, the lethal dosage for ingestion is higher. Ricin is not active upon skin contact.

Treatment for Ricin Exposure

Pre-exposure. There is currently no toxoid vaccine available for use by the general public. The U.S. Department of Defense has investigated toxoid vaccines in animal studies and submitted an Investigational New Drug (IND) application to the Food and Drug Administration in order to test the product in human trials. Research is also being performed in the academic and private sectors regarding the development of new

¹ Ferdinando L. Mirarchi and Michael Allswede, “CBRNE - Ricin,” eMedicine Knowledge base, found online at [<http://www.emedicine.com/emerg/topic889.htm>].

² See *Beyond Anthrax: Extremism and the Bioterrorist Threat*, Anti-Defamation League, 2001 found online at [http://nsi.org/Library/Terrorism/beyond_anthrax.pdf].

³ David R. Franz and Nancy K. Jaax, “Ricin Toxin,” *Medical Aspects of Chemical and Biological Warfare*, (Washington, DC: Borden Institute, Walter Reed Army Medical Center) 1997, Chapter 32, pp. 631-642.

⁴ A microgram is equal to a millionth of a gram.

⁵ David R. Franz and Nancy K. Jaax, *op cit.*

vaccines.⁶ Additionally, animal studies have shown that passive prophylaxis, (i.e., injecting animals with antibodies obtained from other immunized animals), is effective against injected and ingested ricin. For inhaled ricin, the most effective prophylaxis appears to be through vaccination.⁷

Post-exposure. There is currently no specific medicine available to treat ricin exposure. Treatment for ricin exposure is generally supportive and designed to bolster the body's natural response. The progressive nature of the toxin's effects requires hospitalization and continual care. In the cases of ingestion, stomach pumping and treatment with activated charcoal is recommended to limit the effects of ricin.

There is presently no antitoxin available for human use. Post-exposure treatment in animals using toxoid vaccine has proved ineffective, but use of antitoxin treatments have shown to be effective if quickly administered in an aerosol form.⁸

Exposure Detection. There are currently several methods available to detect the release of ricin. Potential field detectors include automated air samplers that could detect the release of aerosolized ricin and swab-type tests that could signal the presence of ricin on surfaces. There are also highly sensitive laboratory-based tests that could be performed on samples gathered on site.⁹ Since these detectors are generally not widely implemented in civilian settings, it is possible that health care workers diagnosing ricin poisoning would be the first to detect a covert ricin attack. Faster, more sensitive detectors are being developed by both military and civilian sectors.

History of Ricin's Use

Ricin has been investigated as a weapon since the 1940s, when military programs investigated the feasibility of developing bombs to disseminate aerosolized ricin. Such a weapon was reportedly developed by the United Kingdom, but never used.¹⁰ More recently, Iraq is thought to have attempted to weaponize ricin.¹¹

In 1978, ricin was used to assassinate Bulgarian dissident Georgi Markov in London. A novel, umbrella-based weapon was used to inject a pellet containing ricin into Markov.

⁶ For example, a recombinant mouse vaccine for ricin was reported by researchers at University of Texas Southwestern Medical School. See Joan E. Smallshaw, Ana Firer, John R. Fulmer, Stephen L. Ruback, Victor Ghetie and Ellen S. Vitetta, "A Novel Recombinant Vaccine Which Protects Mice Against Ricin Intoxication," *Vaccine*, 2002, pp. 3422-3427.

⁷ David R. Franz, and Nancy K. Jaax, *op cit.*

⁸ Institute of Medicine, *Chemical and Biological Terrorism: Research and Development to Improve Civilian Medical Response*, (Washington, DC: National Academy Press) 1999.

⁹ *An Introduction to Biological Agent Detection Equipment for Emergency First Responders*, NIJ Guide 101-00, December, 2001, found online at [<http://www.ncjrs.org/pdffiles1/nij/190747.pdf>].

¹⁰ Jeremy Laurance, "Unnatural History of a Simple but Lethal By-product of Castor Oil Plants", *The Independent*, (London), January 8, 2003.

¹¹ Central Intelligence Agency, *Iraq's Weapons of Mass Destruction Programs*, October 2002.

Shortly after this episode, a similar pellet was discovered to be the source of illness of another Bulgarian exile, Vladimir Kostov.

In 1991, members of a tax-resistance group, the Minnesota Patriots Council, were found in possession of 0.7 grams of ricin. They were arrested and convicted for the possession of a lethal poison for use as a weapon, a violation of the Biological Weapons Anti-Terrorism Act of 1989 (P.L. 101-298).¹²

In 1995, Thomas Lewis Lavy was arrested while crossing into Canada from Alaska. Canadian customs officials seized a white powder later determined to be 130 grams of ricin.¹³ Mr. Lavy was later arrested for possession of a lethal poison for use as a weapon. His intentions for the ricin are unknown, as he committed suicide while in detention.¹⁴

In 1997, Thomas Leahy was arrested for shooting his stepson in the face. In the basement of Leahy's home was a makeshift laboratory where, tests indicated, he had produced ricin.¹⁵ Mr. Leahy pleaded guilty to violating the Biological Weapons Anti-Terrorism Statute.

In 2002, Kenneth Olson was arrested for producing small amounts of ricin.¹⁶ He was found guilty of possession of a biological agent or toxin for use as a weapon, and sentenced to 13 years imprisonment.¹⁷

In January 2003, British law-enforcement arrested six men of North African origin following an intelligence tip. Police later found traces of ricin and manufacturing equipment in a north London apartment.¹⁸

In October 2003, ricin was detected on an envelope processed in a Greenville, South Carolina mail facility. While no postal workers showed symptoms of ricin exposure, the facility was closed until environmental testing concluded that no facility contamination existed.¹⁹ The individual who mailed the ricin has not been identified. The Federal

¹² Jonathan B. Tucker and Jason Pate, "The Minnesota Patriots Council" in *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, Jonathan B. Tucker Ed. (Cambridge, MA: MIT Press) 2000.

¹³ Richard Mostyn, "Stopped at Border, Man Carried Lethal Toxin," *Yukon Times*, February 23, 1996.

¹⁴ Statement for the Record of Robert M. Burnham, Chief, Domestic Terrorism Section, Federal Bureau of Investigation, before the United States House of Representatives Subcommittee on Oversight and Investigations, May 20, 1999.

¹⁵ *Ibid.*

¹⁶ Mike Barber, "Spokane Man Held on Poison Charge; Federal Authorities Say Father of Four Made Deadly Ricin in Plot to Kill His Wife," *The Seattle Post-Intelligencer*, June 20, 2002.

¹⁷ Nicholas K. Geranios, "3-year sentence Given in Ricin Trial," *The Seattle Times*, October 29, 2003.

¹⁸ Michael Holden, "Terror Alert as U.K. Police Hunt Deadly Poison," Reuters, January 8, 2003.

¹⁹ Centers for Disease Control and Prevention, "Investigation of a Ricin-Containing Envelope at (continued...)

Bureau of Investigation has offered a \$100,000 reward for information leading to the individual's arrest.²⁰

In November 2003, the Secret Service reportedly intercepted an envelope addressed to the White House that contained ricin. The letter accompanying the ricin shared similar demands as those found in the South Carolina letter.²¹

Additionally, reports have placed trace amounts of ricin in various locales in Afghanistan,²² and have claimed that Al Qaeda allied groups in Kurdish controlled areas of northern Iraq have experimented with ricin production.²³

Ricin as a Weapon of Terror Rather than Mass Destruction

Many experts believe that it would be difficult to use ricin as a weapon of mass destruction. Ricin needs to be injected, ingested, or inhaled by the victim to injure.²⁴ It is estimated that 8 metric tons would be required to cover a 100 km² area with enough toxin to kill 50% of the people. Thus, deploying ricin to cause mass casualties becomes logistically impractical even for a well-funded terrorist organization.²⁵ Furthermore, some experts have stated that the required preparatory steps to use ricin as a mass casualty weapon poses significant technical barriers that may preclude such use by non-state actors.²⁶

Although causing mass casualties would be difficult, most experts agree that ricin is a formidable weapon if used in small-scale attacks.²⁷ The Centers for Disease Control and Prevention have listed ricin as a Category B Agent because it would be "moderately

¹⁹ (...continued)

a Postal Facility – South Carolina, 2003," *Morbidity and Mortality Weekly Report*, Vol. 52, November 21, 2003, pp. 1129-1131.

²⁰ Jesse J. Holland, "FBI Offers Reward in Ricin-Package Case," *Washington Post*, January 8, 2004.

²¹ Dan Eggen, "Letter With Ricin Vial Sent to White House," *Washington Post*, February 4, 2004.

²² "Terror Police Find Deadly Poison," *BBC News*, Tuesday, January 7, 2003.

²³ Heather Langan, "Britons Seize Poison Linked to al-Qaida," *Salt Lake Tribune*, January 8, 2003.

²⁴ Some have suggested that ricin may be converted into a contact poison when combined with a solvent that can penetrate the skin. Reportedly, the Minnesota Patriots Council planned to use this delivery method. See Jonathan B. Tucker and Jason Pate, *op cit*.

²⁵ Mark Kortepeter and Gerald Parker, "Potential biological weapons threats," *Emerging Infectious Diseases*, Vol. 5, No. 4, July-August 1999, pp. 523-527.

²⁶ U.S. Congress, Office of Technology Assessment, *Technologies Underlying Weapons of Mass Destruction*, OTA-BP-ISC-115, (Washington, DC: Government Printing Office, December 1993) p. 82.

²⁷ *Ibid.*

easy to disseminate and result in moderate morbidity rates and low mortality rates.”²⁸ Although a string of attacks targeting dozens of victims at a time may not produce mass devastation, they might instill terror in the population causing local economic disruption.

Current Regulation

Ricin is listed on the Select Agent list (42 CFR 72) and possession, transfer, and use of ricin is restricted under the Public Health Security and Bioterrorism Preparedness Act of 2002 (P.L. 107-188).²⁹ Access to stores of ricin is limited to select bona fide researchers under the USA PATRIOT Act (P.L. 107-56). It is not illegal to possess or transfer castor beans, nor castor bean plants, because agents on the select agent list are exempt if they are in their natural state and no effort has been made to isolate the active agent (18 USC 175). Both castor beans and castor bean plants are openly sold within the United States, and castor bean plants grow naturally in the southwest.

The United States is a party to both the Biological Weapons Convention and the Chemical Weapons Convention. Ricin is a prohibited substance under both of these conventions. The Biological Weapons Convention bans the development, production, and stockpiling of biological agents or toxins for non-peaceful purposes. The Chemical Weapons Convention bans the development, production, stockpiling, transfer, and use of chemical weapons. The United States has entered into multilateral agreements to prevent the development of both chemical and biological weapons by other nations and terrorist groups.³⁰

²⁸ The full CDC list is available online at: [<http://www.bt.cdc.gov/Agent/agentlist.asp>].

²⁹ For more information on the Select Agent Rule and accompanying criminal penalties see CRS Report RL31263 *Public Health Security and Bioterrorism Preparedness and Response Act (P.L. 107-188): Provisions and Changes to Preexisting Law*.

³⁰ For more information on this topic, see CRS Report RL31559 *Proliferation Control Regimes: Background and Status*, coordinated by Sharon A. Squassoni.